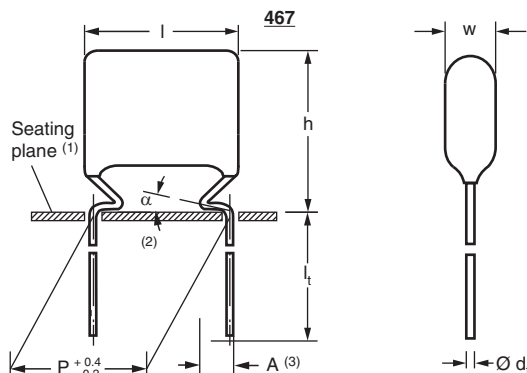
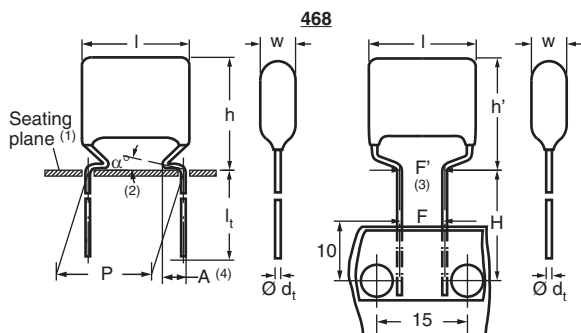


DC Film Capacitors MKT Radial Lacquered Type



Notes

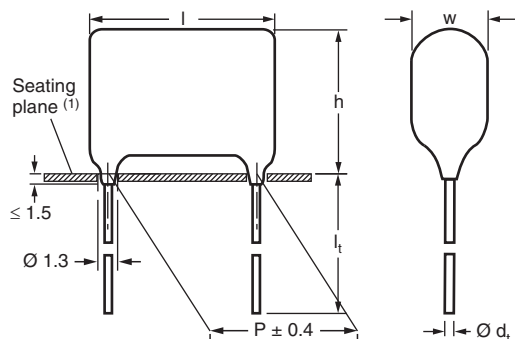
- (1) Hole Ø 1.0 mm for $d_t = 0.6$ mm
- (2) $0 \leq \alpha < 50^\circ$
- (3) $A = 2.0 \text{ mm} \pm 0.5 \text{ mm}$



Notes

- (1) Hole Ø 1.0 mm for $d_t = 0.8$ mm
- (2) $0 \leq \alpha < 50^\circ$
- (3) $|F - F'| < 0.3 \text{ mm}$
 $F = 7.5 \text{ mm} + 0.6 \text{ mm} / - 0.1 \text{ mm}$
- (4) $A = 2.5 \text{ mm} + 1.4 \text{ mm} / - 0.5 \text{ mm} \pm 0.3 \text{ mm}$

469 Straight Leads



Note

- (1) Hole Ø 1.0 for $d_t = 0.6$ mm

CONSTRUCTION

Mono construction

FEATURES

- Available taped and loose in box
- Material categorization:
for definitions of compliance please see
www.vishay.com/doc?99912



RoHS
COMPLIANT

APPLICATIONS

Blocking and coupling, bypass and energy reservoir.

REFERENCE STANDARDS

IEC 60384-2

MARKING

C-value; tolerance; rated voltage; code for manufacturer;
manufacturer's type; manufacturer's logo

DIELECTRIC

Polyester film

ELECTRODES

Metallized

RATED (DC) VOLTAGE

100 V, 250 V, 400 V, 630 V

RATED (AC) VOLTAGE

63 V, 160 V, 220 V, 250 V

ENCAPSULATION

Flame retardant epoxy material (UL-class 94 V-0)

CLIMATIC TESTING CLASS ACCORDING TO IEC 60068-1

55/105/56

RATED TEMPERATURE

85 °C

CAPACITANCE RANGE (E12 SERIES)

467: 0.001 µF to 1.0 µF

468: 0.039 µF to 10.0 µF

469: 0.001 µF to 1.0 µF

CAPACITANCE TOLERANCE

± 10 %, ± 5 %

LEADS

Tinned wire

MAXIMUM APPLICATION TEMPERATURE

105 °C

DETAIL SPECIFICATION

For more detailed data and test requirements contact:
dc-film@vishay.com



COMPOSITION OF CATALOG NUMBER: 467

TYPE AND PITCHES		CAPACITANCE (numerically)		MULTIPLIER (nF)	
467	10.0 mm			0.1	2
				1	3
				10	4
				100	5

BFC2	467	XX	YY	Y
2222 (*)	467	XX	YY	Y

(*) Old ordering number

Example:
104 = 10 x 10 = 100 nF

TYPE	PACKAGING	LEAD CONFIGURATION	PREFERRED TYPES				
			C-TOL.	100 V	250 V	400 V	630 V
467	Loose in box	Lead length 3.5 mm + 1.0 mm/- 0.5 mm	± 10 %	04	16	28	40
			± 5 %	05	17	29	41
		Lead length 19.0 mm ± 4.0 mm	± 10 %	51	53	55	57
			± 5 %	52	54	56	58
	Taped on reel (1)	H = 16.0 mm; P ₀ = 12.7 mm Reel diameter = 500 mm	± 10 %	06	18	30	42
			± 5 %	07	19	31	43

Note

(1) For detailed tape specifications refer to packaging information: www.vishay.com/doc?28139

SPECIFIC REFERENCE DATA: 467

DESCRIPTION	VALUE			
Tangent of loss angle: C ≤ 0.1 μF 0.1 μF < C ≤ 0.47 μF 0.47 μF < C ≤ 1.0 μF	at 1 kHz	at 10 kHz	at 100 kHz	
	≤ 75 x 10 ⁻⁴	≤ 120 x 10 ⁻⁴	≤ 200 x 10 ⁻⁴	
	≤ 75 x 10 ⁻⁴	≤ 120 x 10 ⁻⁴	≤ 225 x 10 ⁻⁴	
	≤ 75 x 10 ⁻⁴	≤ 120 x 10 ⁻⁴	-	
Rated voltage pulse slope (dU/dt) _R at I _{max.} = 12.5 mm	100 V _{DC}	250 V _{DC}	400 V _{DC}	630 V _{DC}
	30 V/μs	120 V/μs	170 V/μs	120 V/μs
R between leads, for C ≤ 0.33 μF at 100 V; 1 min at 500 V; 1 min	> 15 000 MΩ	> 30 000 MΩ	> 30 000 MΩ	> 30 000 MΩ
R between leads, for C > 0.33 μF at 100 V; 1 min at 500 V; 1 min	> 5000 s	> 10 000 s	> 10 000 s	> 10 000 s
R between interconnecting leads and casing, at 100 V; 1 min at 500 V; 1 min	> 30 000 MΩ			
Withstanding (DC) voltage (cut off current 10 mA) (1); rise time ≤ 1000 V/s	160 V; 1 min	400 V; 1 min	640 V; 1 min	1008 V; 1 min
Withstanding (DC) voltage between leads and case	200 V; 1 min	500 V; 1 min	800 V; 1 min	1260 V; 1 min
Maximum application temperature	105 °C			

Note

(1) See "Voltage Proof Test for Metallized Film Capacitors": www.vishay.com/doc?28169

 $U_{RDC} = 100\text{ V}$; $U_{RAC} = 63\text{ V}$

C (μF)	DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 467 XXYYY AND PACKAGING						
			LOOSE IN BOX				REEL		C-VALUE
			l _t = 3.5 mm + 1.0 mm / - 0.5 mm		l _t = 19.0 mm ± 4.0 mm		H = 16.0 mm; P ₀ = 12.7 mm		
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	..YYY
Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm									
0.056	4.0 x 14.0 x 12.5	0.37	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1500)	07... (1500)	563
0.068									683
0.082									823
0.10									104
0.12	4.3 x 14.3 x 12.5	0.40	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1500)	07... (1500)	124
0.15	4.0 x 14.0 x 12.5	0.37	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1500)	07... (1500)	154
0.18	4.2 x 14.2 x 12.5	0.39	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1500)	07... (1500)	184
0.22	4.5 x 14.6 x 12.5	0.43	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1300)	07... (1300)	224
0.27	4.2 x 14.2 x 12.5	0.39	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1500)	07... (1500)	274
0.33	4.6 x 14.6 x 12.5	0.44	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1300)	07... (1300)	334
0.39	4.0 x 14.0 x 12.5	0.37	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1500)	07... (1500)	394
0.47	4.2 x 14.2 x 12.5	0.39	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1500)	07... (1500)	474
0.56	4.6 x 14.6 x 12.5	0.44	04... (2000)	05... (2000)	51... (1500)	52... (1500)	06... (1300)	07... (1300)	564
0.68	5.0 x 15.0 x 12.5	0.50	04... (1500)	05... (1500)	51... (1250)	52... (1250)	06... (1200)	07... (1200)	684
0.82	5.5 x 15.5 x 12.5	0.60	04... (1500)	05... (1500)	51... (1000)	52... (1000)	06... (1100)	07... (1100)	824
1.0	6.0 x 16.0 x 12.5	0.75	04... (1250)	05... (1250)	51... (1000)	52... (1000)	06... (1000)	07... (1000)	105

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only



$U_{RDC} = 250 \text{ V}$; $U_{RAC} = 160 \text{ V}$

C (μF)	DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 467 XXYYY AND PACKAGING						
			LOOSE IN BOX				REEL		C-VALUE
			l _t = 3.5 mm + 1.0 mm /- 0.5 mm		l _t = 19.0 mm ± 4.0 mm		H = 16.0 mm; P ₀ = 12.7 mm		
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	..YYY
Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm									
0.027	4.2 x 14.2 x 12.5	0.39	16... (2000)	17... (2000)	53... (1500)	54... (1500)	18... (1500)	19... (1500)	273
0.033	4.6 x 14.6 x 12.5	0.44	16... (2000)	17... (2000)	53... (1500)	54... (1500)	18... (1300)	19... (1300)	333
0.039	4.0 x 14.0 x 12.5	0.37	16... (2000)	17... (2000)	53... (1500)	54... (1500)	18... (1500)	19... (1500)	393
0.047	4.1 x 14.1 x 12.5	0.38	16... (2000)	17... (2000)	53... (1500)	54... (1500)	18... (1500)	19... (1500)	473
0.056	4.0 x 14.0 x 12.5	0.37	16... (2000)	17... (2000)	53... (1500)	54... (1500)	18... (1500)	19... (1500)	563
0.068	4.1 x 14.1 x 12.5	0.38	16... (2000)	17... (2000)	53... (1500)	54... (1500)	18... (1500)	19... (1500)	683
0.082	4.4 x 14.4 x 12.5	0.41	16... (2000)	17... (2000)	53... (1500)	54... (1500)	18... (1500)	19... (1500)	823
0.10	4.0 x 14.0 x 12.5	0.37	16... (2000)	17... (2000)	53... (1500)	54... (1500)	18... (1500)	19... (1500)	104
0.12	4.3 x 14.3 x 12.5	0.40	16... (2000)	17... (2000)	53... (1500)	54... (1500)	18... (1500)	19... (1500)	124
0.15	4.8 x 14.8 x 12.5	0.48	16... (2000)	17... (2000)	53... (1250)	54... (1250)	18... (1300)	19... (1300)	154
0.18	5.2 x 15.2 x 12.5	0.52	16... (1500)	17... (1500)	53... (1000)	54... (1000)	18... (1200)	19... (1200)	184
0.22	5.8 x 15.8 x 12.5	0.67	16... (1500)	17... (1500)	53... (1000)	54... (1000)	18... (1100)	19... (1100)	224

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only

 $U_{RDC} = 400\text{ V}$; $U_{RAC} = 220\text{ V}$

C (μF)	DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 467 XYYYY AND PACKAGING														
			LOOSE IN BOX				REEL		C-VALUE								
			l _t = 3.5 mm + 1.0 mm / - 0.5 mm		l _t = 19.0 mm ± 4.0 mm		H = 16.0 mm; P ₀ = 12.7 mm										
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %									
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)		..YYY							
Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm																	
0.0010 0.0012 0.0015 0.0018	4.5 x 14.5 x 12.5	0.43	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1300)	31... (1300)	102 122 152 182								
0.0022									4.0 x 14.0 x 12.5	0.37	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	222
0.0027									4.3 x 14.3 x 12.5	0.40	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	272
0.0033									4.6 x 14.6 x 12.5	0.44	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1300)	31... (1300)	332
0.0039	4.0 x 14.0 x 12.5	0.37	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	393								
0.0047	4.1 x 14.2 x 12.5	0.38	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	472								
0.0056	4.6 x 14.6 x 12.5	0.44	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1300)	31... (1300)	562								
0.0068	4.2 x 14.2 x 12.5	0.39	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	682								
0.0082	4.6 x 14.6 x 12.5	0.44	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1300)	31... (1300)	822								
0.010	4.1 x 14.1 x 12.5	0.38	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	103								
0.012	4.5 x 14.5 x 12.5	0.43	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1300)	31... (1300)	123								
0.015	4.1 x 14.1 x 12.5	0.38	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	153								
0.018	4.5 x 14.5 x 12.5	0.43	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1300)	31... (1300)	183								
0.022	4.0 x 14.0 x 12.5	0.37	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	223								
0.027	4.2 x 14.2 x 12.5	0.39	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	273								
0.033	4.6 x 14.7 x 12.5	0.44	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1300)	31... (1300)	333								
0.039	5.0 x 14.9 x 12.5	0.50	28... (1500)	29... (1500)	55... (1250)	56... (1250)	30... (1200)	31... (1200)	393								
0.047	4.1 x 14.1 x 12.5	0.38	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	473								
0.056	4.4 x 14.4 x 12.5	0.41	28... (2000)	29... (2000)	55... (1500)	56... (1500)	30... (1500)	31... (1500)	563								
0.068	4.8 x 14.8 x 12.5	0.48	28... (2000)	29... (2000)	55... (1250)	56... (1250)	30... (1300)	31... (1300)	683								
0.082	5.4 x 15.3 x 12.5	0.57	28... (1500)	29... (1500)	55... (1000)	56... (1000)	30... (1200)	31... (1200)	823								
0.10	5.7 x 15.7 x 12.5	0.64	28... (1500)	29... (1500)	55... (1000)	56... (1000)	30... (1100)	31... (1100)	104								

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only

 $U_{RDC} = 630 \text{ V}$; $U_{RAC} = 250 \text{ V}$

C (μF)	DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 467 XYYYY AND PACKAGING						
			LOOSE IN BOX				REEL		C-VALUE
			l _t = 3.5 mm + 1.0 mm / - 0.5 mm		l _t = 19.0 mm ± 4.0 mm		H = 16.0 mm; P ₀ = 12.7 mm		
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	..YYY
Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm									
0.010	4.1 x 14.1 x 12.5	0.38	40... (2000)	41... (2000)	57... (1500)	58... (1500)	42... (1500)	43... (1500)	103
0.012	4.5 x 14.5 x 12.5	0.43	40... (2000)	41... (2000)	57... (1500)	58... (1500)	42... (1300)	43... (1300)	123
0.015	4.9 x 14.9 x 12.5	0.49	40... (2000)	41... (2000)	57... (1250)	58... (1250)	42... (1200)	43... (1200)	153
0.018	5.4 x 15.4 x 12.5	0.57	40... (1500)	41... (1500)	57... (1000)	58... (1000)	42... (1100)	43... (1100)	183
0.022	4.8 x 14.8 x 12.5	0.48	40... (2000)	41... (2000)	57... (1250)	58... (1250)	42... (1300)	43... (1300)	223
0.027	5.3 x 15.3 x 12.5	0.55	40... (2000)	41... (2000)	57... (1000)	58... (1000)	42... (1200)	43... (1200)	273
0.033	5.9 x 15.9 x 12.5	0.70	40... (1500)	41... (1500)	57... (1000)	58... (1000)	42... (1100)	43... (1100)	333

Notes

- SPQ = Standard Packing Quantity

⁽¹⁾ Net weight for short lead product only



COMPOSITION OF CATALOG NUMBER: 468

TYPE AND PITCHES		CAPACITANCE (numerically)		MULTIPLIER (nF)	
468	15.0 mm/7.5 mm			0.1	2
	15.0 mm	1	3		
	22.5 mm	10	4		
	27.5 mm	100	5		

Example:
104 = 10 x 10 = 100 nF

BFC2	468	XX	YY	Y
2222 (*)	468	XX	YY	Y

(*) Old ordering number

TYPE	PACKAGING	LEAD CONFIGURATION	PREFERRED TYPES				
			C-TOL.	100 V	250 V	400 V	630 V
468	Loose in box	Lead length 3.5 mm + 1.0 mm/- 0.5 mm (Pitch 10 mm and 15 mm)	± 10 %	04	16	28	40
			± 5 %	05	17	29	41
		Long leads: 19.0 mm ± 4.0 mm for lead pitch = 15.0 mm 25.0 mm ± 4.0 mm for lead pitch = 22.5 mm 24.0 mm ± 4.0 mm for lead pitch = 27.5 mm	± 10 %	51	53	55	57
			± 5 %	52	54	56	58
			± 10 %	61	63	65	67
			± 5 %	62	64	66	68
	Taped on reel ⁽¹⁾ (bent back)	H = 16.0 mm; P ₀ = 15.0 mm Reel diameter = 500 mm ⁽²⁾	Dimensions of these code numbers stay between brackets				
			± 10 %	06	18	30	42
	Taped on reel ⁽¹⁾	H = 16.0 mm; P ₀ = 12.7 mm Reel diameter = 500 mm	± 10 %	07	19	31	43
			± 5 %	07	19	31	43

Notes

- (1) For detailed tape specifications refer to packaging information: www.vishay.com/doc?28139
 (2) Small reel diameter = 356 mm is available on request

SPECIFIC REFERENCE DATA: 468

DESCRIPTION	VALUE			
	at 1 kHz	at 10 kHz	at 100 kHz	
Tangent of loss angle: C ≤ 0.1 μF	≤ 75 x 10 ⁻⁴	≤ 120 x 10 ⁻⁴	≤ 200 x 10 ⁻⁴	
0.1 μF < C ≤ 0.47 μF	≤ 75 x 10 ⁻⁴	≤ 120 x 10 ⁻⁴	≤ 225 x 10 ⁻⁴	
0.47 μF < C ≤ 1.0 μF	≤ 75 x 10 ⁻⁴	≤ 150 x 10 ⁻⁴	-	
Rated voltage pulse slope (dU/dt) _R at	100 V _{DC}	250 V _{DC}	400 V _{DC}	630 V _{DC}
I _{max.} = 12.5 mm	30 V/μs	120 V/μs	170 V/μs	120 V/μs
I _{max.} = 17.5 mm	20 V/μs	45 V/μs	65 V/μs	90 V/μs
I _{max.} = 26.0 mm	10 V/μs	20 V/μs	30 V/μs	35 V/μs
I _{max.} = 30.0 mm		15 V/μs	25 V/μs	30 V/μs
R between leads, for C ≤ 0.33 μF at 100 V; 1 min at 500 V; 1 min	> 15 000 MΩ	> 30 000 MΩ	> 30 000 MΩ	> 30 000 MΩ
R between leads, for C > 0.33 μF at 100 V; 1 min at 500 V; 1 min	> 5000 s	> 10 000 s	> 10 000 s	> 10 000 s
R between interconnecting leads and casing, at 100 V; 1 min at 500 V; 1 min	> 30 000 MΩ	> 30 000 MΩ	> 30 000 MΩ	> 30 000 MΩ
Withstanding (DC) voltage (cut off current 10 mA) ⁽¹⁾ ; rise time ≤ 1000 V/s	160 V; 1 min	400 V; 1 min	640 V; 1 min	1008 V; 1 min
Withstanding (DC) voltage between leads and case	200 V; 1 min	500 V; 1 min	800 V; 1 min	1260 V; 1 min
Maximum application temperature	105 °C			

Note

- (1) See "Voltage Proof Test for Metallized Film Capacitors": www.vishay.com/doc?28169

 $U_{RDC} = 100\text{ V}$; $U_{RAC} = 63\text{ V}$

C (μ F)	DIMENSIONS $w_{\text{max.}} \times h \text{ (h')}_{\text{max.}} \times l_{\text{max.}}$ (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 468 XXYYY AND PACKAGING								C- VALUE
			LOOSE IN BOX				REEL H = 16.0 mm				
							ORIGINAL PITCH		BENT BACK PITCH		
			C-TOL. = $\pm 10 \%$	C-TOL. = $\pm 5 \%$	C-TOL. = $\pm 10 \%$	C-TOL. = $\pm 5 \%$	C-TOL. = $\pm 10 \%$	C-TOL. = $\pm 5 \%$	C-TOL. = $\pm 10 \%$	C-TOL. = $\pm 5 \%$	
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	
Pitch = 15.0 mm $\pm$ 0.4 mm; d_t = 0.80 mm $\pm$ 0.08 mm											
			l_t = 3.5 mm + 1.0 mm / - 0.5 mm		l_t = 19.0 mm $\pm$ 4.0 mm		P = 15 mm P_0 = 12.7 mm		P = 7.5 mm P_0 = 15.0 mm		
1.2	5.5 x 14.5 (16.0) x 17.5	0.90	04... (2000)	05... (2000)	51... (1250)	52... (1250)	06... (1100)	07... (1100)	61... (900)	62... (900)	125
1.5	6.0 x 15.0 (16.5) x 17.5	1.00	04... (2000)	05... (2000)	51... (1250)	52... (1250)	06... (1000)	07... (1000)	61... (800)	62... (800)	155
1.8	6.5 x 15.5 (17.0) x 17.5	1.15	04... (1500)	05... (1500)	51... (1000)	52... (1000)	06... (900)	07... (900)	61... (750)	62... (750)	185
2.2	7.0 x 16.0 (17.5) x 17.5	1.25	04... (1250)	05... (1250)	51... (1000)	52... (1000)	06... (800)	07... (800)	61... (700)	62... (700)	225
2.7	8.0 x 17.0 (18.5) x 17.5	1.50	04... (1000)	05... (1000)	51... (1000)	52... (1000)	06... (750)	07... (750)	61... (600)	62... (600)	275
3.3	8.5 x 17.5 (19.0) x 17.5	1.70	04... (1000)	05... (1000)	51... (1000)	52... (1000)	06... (700)	07... (700)	61... (550)	62... (550)	335
Pitch = 22.5 mm $\pm$ 0.4 mm; d_t = 0.80 mm $\pm$ 0.08 mm											
			l_t = 3.5 mm $\pm$ 0.5 mm		l_t = 25.0 mm $\pm$ 4.0 mm		P = 22.5 mm P_0 = 12.7 mm		P = 7.5 mm P_0 = 15.0 mm		
3.9	6.5 x 18.5 x 26.0	2.1	04... (1000)	05... (1000)	51... (750)	52... (750)					395
4.7	7.0 x 19.5 x 26.0	2.3	04... (900)	05... (900)	51... (700)	52... (700)					475
5.6	7.5 x 20.0 x 26.0	2.5	04... (750)	05... (750)	51... (600)	52... (600)					565
6.8	8.5 x 21.5 x 26.0	3.2	04... (750)	05... (750)	51... (500)	52... (500)					685
8.2	9.5 x 22.5 x 26.0	3.4	04... (700)	05... (700)	51... (500)	52... (500)					825
10.0	10.5 x 23.5 x 26.0	3.8	04... (500)	05... (500)	51... (400)	52... (400)					106

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only

 $U_{RDC} = 250 \text{ V}$; $U_{RAC} = 160 \text{ V}$

C (μF)	DIMENSIONS w _{max.} x h (h') _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 468 XYYYY AND PACKAGING									
			LOOSE IN BOX				REEL H = 16.0 mm				C- VALUE ..YYY	
							ORIGINAL PITCH		BENT BACK PITCH			
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %		
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)		
Pitch = 15.0 mm ± 0.4 mm; d _t = 0.80 mm ± 0.08 mm												
			l _t = 3.5 mm + 1.0 mm/- 0.5 mm		l _t = 19.0 mm ± 4.0 mm		P = 15 mm P ₀ = 12.7 mm		P = 7.5 mm P ₀ = 15.0 mm			
0.27	5.0 x 14.0 (15.5) x 17.5	0.80	16... (2000)	17... (2000)	53... (1250)	54... (1250)	18... (1200)	19... (1200)	63... (1000)	64... (1000)	274	
0.33	5.5 x 14.5 (16.0) x 17.5	0.90	16... (2000)	17... (2000)	53... (1250)	54... (1250)	18... (1100)	19... (1100)	63... (900)	64... (900)	334	
0.39	6.0 x 15.0 (16.5) x 17.5	1.00	16... (2000)	17... (2000)	53... (1250)	54... (1250)	18... (1000)	19... (1000)	63... (800)	64... (800)	394	
0.47	6.5 x 15.5 (17.0) x 17.5	1.15	16... (1500)	17... (1500)	53... (1000)	54... (1000)	18... (900)	19... (900)	63... (750)	64... (750)	474	
0.56	7.5 x 16.5 (18.0) x 17.5	1.30	16... (1250)	17... (1250)	53... (1000)	54... (1000)	18... (800)	19... (800)	63... (650)	64... (650)	564	
0.68	8.0 x 17.0 (18.5) x 17.5	1.50	16... (1000)	17... (1000)	53... (1000)	54... (1000)	18... (750)	19... (750)	63... (600)	64... (600)	684	
0.82	8.5 x 17.5 (19.0) x 17.5	1.70	16... (1000)	17... (1000)	53... (1000)	54... (1000)	18... (700)	19... (700)	63... (550)	64... (550)	824	
1.0	8.0 x 20.0 (21.5) x 17.5	2.10	16... (1000)	17... (1000)	53... (900)	54... (900)	18... (750)	19... (750)	63... (600)	64... (600)	105	
Pitch = 22.5 mm ± 0.4 mm; d _t = 0.80 mm ± 0.08 mm												
			l _t = 3.5 mm ± 0.5 mm		l _t = 25.0 mm ± 4.0 mm		P = 22.5 mm P ₀ = 12.7 mm		P = 7.5 mm P ₀ = 15.0 mm			
1.2	7.0 x 19.0 x 26.0	2.3	16... (1000)	17... (1000)	53... (700)	54... (700)	-		-		125	
1.5	8.0 x 21.0 x 26.0	2.8	16... (750)	17... (750)	53... (500)	54... (500)					155	
1.8	9.0 x 22.0 x 26.0	3.3	16... (750)	17... (750)	53... (500)	54... (500)					185	
2.2	9.8 x 23.0 x 26.0	3.4	16... (750)	17... (750)	53... (450)	54... (450)					225	
2.7	11.0 x 24.0 x 26.0	4.0	16... (500)	17... (500)	53... (400)	54... (400)					275	
3.3	12.5 x 25.5 x 26.0	4.5	16... (500)	17... (500)	53... (300)	54... (300)					335	
3.9	13.5 x 26.5 x 26.0	5.5	16... (400)	17... (400)	53... (300)	54... (300)					395	
4.7	14.9 x 28.0 x 26.0	6.3	16... (250)	17... (250)	53... (250)	54... (250)					475	
Pitch = 27.5 mm ± 0.4 mm; d _t = 0.80 mm ± 0.08 mm; A = 2.5 mm + 1.4 mm / - 0.5 mm												
			l _t = 3.5 mm ± 0.5 mm		l _t = 24.0 mm ± 4.0 mm		P = 27.5 mm P ₀ = 12.7 mm		P = 7.5 mm P ₀ = 15.0 mm			
5.6	15.0 x 28.0 x 30.0	7.5	16... (300)	17... (300)	53... (200)	54... (200)	-		-		565	

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only

 $U_{RDC} = 400\text{ V}$; $U_{RAC} = 220\text{ V}$

C (μF)	DIMENSIONS w _{max.} x h (h') _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 468 XYYYY AND PACKAGING									C- VALUE
			LOOSE IN BOX				REEL H = 16.0 mm					
							ORIGINAL PITCH		BENT BACK PITCH			
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %		
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	..YYY	
Pitch = 15.0 mm ± 0.4 mm; d _t = 0.80 mm ± 0.08 mm												
			l _t = 3.5 mm + 1.0 mm / - 0.5 mm		l _t = 19.0 mm ± 4.0 mm		P = 15 mm P ₀ = 12.7 mm		P = 7.5 mm P ₀ = 15.0 mm			
0.12	5.0 x 14.0 (15.5) x 17.5	0.80	28... (2000)	29... (2000)	55... (1250)	56... (1250)	30... (1200)	31... (1200)	65... (1000)	66... (1000)	124	
0.15	5.8 x 15.0 (16.5) x 17.5	0.95	28... (1750)	29... (1750)	55... (1250)	56... (1250)	30... (1100)	31... (1100)	65... (850)	66... (850)	154	
0.18	6.5 x 15.5 (17.0) x 17.5	1.15	28... (1500)	29... (1500)	55... (1000)	56... (1000)	30... (900)	31... (900)	65... (750)	66... (750)	184	
0.22	7.0 x 16.0 (17.5) x 17.5	1.25	28... (1500)	29... (1500)	55... (1000)	56... (1000)	30... (800)	31... (800)	65... (700)	66... (700)	224	
0.27	7.4 x 16.5 (18.0) x 17.5	1.28	28... (1250)	29... (1250)	55... (1250)	56... (1250)	30... (800)	31... (800)	65... (650)	66... (650)	274	
0.33	8.5 x 17.5 (19.0) x 17.5	1.70	28... (1000)	29... (1000)	55... (1000)	56... (1000)	30... (700)	31... (700)	65... (550)	66... (550)	334	
0.39	7.4 x 19.5 (21.0) x 17.5	2.00	28... (1000)	29... (1000)	55... (1000)	56... (1000)	30... (800)	31... (800)	65... (650)	66... (650)	394	
0.47	8.4 x 20.5 (22.0) x 17.5	2.10	28... (750)	29... (750)	55... (850)	56... (850)	30... (700)	31... (700)	65... (550)	66... (550)	474	
Pitch = 22.5 mm ± 0.4 mm; d _t = 0.80 mm ± 0.08 mm												
			l _t = 3.5 mm ± 0.5 mm		l _t = 25.0 mm ± 4.0 mm		P = 22.5 mm P ₀ = 12.7 mm		P = 7.5 mm P ₀ = 15.0 mm			
0.56	7.0 x 19.5 x 26.0	2.5	28... (1000)	29... (1000)	55... (650)	56... (650)	-		-		564	
0.68	8.0 x 21.0 x 26.0	2.8	28... (750)	29... (750)	55... (500)	56... (500)					684	
0.82	9.0 x 22.0 x 26.0	3.3	28... (750)	29... (750)	55... (500)	56... (500)					824	
1.0	9.9 x 23.0 x 26.0	3.5	28... (750)	29... (750)	55... (450)	56... (450)					105	
1.2	11.0 x 24.0 x 26.0	4.0	28... (500)	29... (500)	55... (400)	56... (400)					125	
Pitch = 27.5 mm ± 0.4 mm; d _t = 0.80 mm ± 0.08 mm; A = 2.5 mm + 1.4 mm / - 0.5 mm												
			l _t = 3.5 mm ± 0.5 mm		l _t = 24.0 mm ± 4.0 mm		P = 27.5 mm P ₀ = 12.7 mm		P = 7.5 mm P ₀ = 15.0 mm			
1.5	11.5 x 24.5 x 30.0	5.8	28... (450)	29... (450)	55... (300)	56... (300)	-		-		155	
1.8	12.5 x 25.5 x 30.0	6.4	28... (350)	29... (350)	55... (250)	56... (250)					185	
2.2	14.0 x 27.0 x 30.0	7.3	28... (300)	29... (300)	55... (200)	56... (200)					225	

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only

 $U_{RDC} = 630 \text{ V}$; $U_{RAC} = 250 \text{ V}$

C (μF)	DIMENSIONS w _{max.} x h (h') _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 468 XYYYY AND PACKAGING									
			LOOSE IN BOX				REEL H = 16.0 mm				C- VALUE	
							ORIGINAL PITCH		BENT BACK PITCH			
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %		
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)		..YYY
Pitch = 15.0 mm ± 0.4 mm; d _t = 0.80 mm ± 0.08 mm												
			l _t = 3.5 mm + 1.0 mm/- 0.5 mm		l _t = 19.0 mm ± 4.0 mm		P = 15 mm P ₀ = 12.7 mm		P = 7.5 mm P ₀ = 15.0 mm			
0.039	5.0 x 14.0 (15.5) x 17.5	0.80	40... (2000)	41... (2000)	57... (1250)	58... (1250)	42... (1200)	43... (1200)	67... (1000)	68... (1000)	393	
0.047	5.5 x 14.5 (16.0) x 17.5	0.90	40... (2000)	41... (2000)	57... (1250)	58... (1250)	42... (1100)	43... (1100)	67... (900)	68... (900)	473	
0.056	5.9 x 15.0 (16.5) x 17.5	0.95	40... (1750)	41... (1750)	57... (1250)	58... (1250)	42... (1000)	43... (1000)	67... (850)	68... (850)	563	
0.068	6.5 x 16.0 (17.5) x 17.5	1.15	40... (1500)	41... (1500)	57... (1000)	58... (1000)	42... (800)	43... (800)	67... (750)	68... (750)	683	
0.082	7.3 x 16.5 (18.0) x 17.5	1.27	40... (1500)	41... (1500)	57... (1000)	58... (1000)	42... (800)	43... (800)	67... (650)	68... (650)	823	
0.10	7.9 x 17.0 (18.5) x 17.5	1.48	40... (1250)	41... (1250)	57... (1000)	58... (1000)	42... (750)	43... (750)	67... (600)	68... (600)	104	
0.12	7.5 x 19.5 (21.0) x 17.5	2.00	40... (1250)	41... (1250)	57... (1000)	58... (1000)	42... (800)	43... (800)	67... (650)	68... (650)	124	
0.15	8.5 x 20.5 (22.0) x 17.5	2.20	40... (1000)	41... (1000)	57... (850)	58... (850)	42... (700)	43... (700)	67... (550)	68... (550)	154	
Pitch = 22.5 mm ± 0.4 mm; d _t = 0.80 mm ± 0.08 mm												
			l _t = 3.5 mm ± 0.5 mm		l _t = 25.0 mm ± 4.0 mm		P = 22.5 mm P ₀ = 12.7 mm		P = 7.5 mm P ₀ = 15.0 mm			
0.18	7.5 x 19.5 x 26.0	2.5	40... (1000)	41... (1000)	57... (650)	58... (650)	-		-		184	
0.22	8.0 x 21.0 x 26.0	2.8	40... (750)	41... (750)	57... (500)	58... (500)					224	
0.27	9.0 x 22.0 x 26.0	3.3	40... (750)	41... (750)	57... (500)	58... (500)					274	
0.33	10.0 x 23.0 x 26.0	3.5	40... (700)	41... (700)	57... (450)	58... (450)					334	
0.39	11.5 x 24.0 x 26.0	4.2	40... (600)	41... (600)	57... (400)	58... (400)					394	
0.47	12.5 x 25.5 x 26.0	4.5	40... (500)	41... (500)	57... (300)	58... (300)					474	
0.56	13.5 x 26.6 x 26.0	5.5	40... (450)	41... (450)	57... (300)	58... (300)					564	
0.68	15.0 x 28.0 x 26.0	6.5	40... (400)	41... (400)	57... (250)	58... (250)					684	
Pitch = 27.5 mm ± 0.4 mm; d _t = 0.80 mm ± 0.08 mm; A = 2.5 mm + 1.4 mm / - 0.5 mm												
			l _t = 3.5 mm ± 0.5 mm		l _t = 24.0 mm ± 4.0 mm		P = 27.5 mm P ₀ = 12.7 mm		P = 7.5 mm P ₀ = 15.0 mm			
0.82	15.0 x 28.0 x 30.0	7.5	40... (300)	41... (300)	57... (200)	58... (200)	-		-		-	

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only



COMPOSITION OF CATALOG NUMBER: 469

TYPE AND PITCHES		CAPACITANCE (numerically)	MULTIPLIER (nF)	
469	10.0 mm		0.1	2
			1	3
			10	4
			100	5

BFC2	469	XX	YY	Y
2222 (*)	469	XX	YY	Y

(*) Old ordering number

Example:
104 = 10 x 10 = 100 nF

TYPE	PACKAGING	LEAD CONFIGURATION	PREFERRED TYPES				
			C-TOL.	100 V	250 V	400 V	630 V
469	Loose in box	Lead length 4.0 mm + 1.0 mm/- 0.5 mm	± 10 %	25	45	55	65
			± 5 %	26	46	56	66
		Lead length 22.0 mm ± 4.0 mm	± 10 %	21	41	51	61
			± 5 %	22	42	52	62
	Taped on reel ⁽¹⁾	H = 18.5 mm; P ₀ = 12.7 mm Reel diameter = 500 mm	± 10 %	28	48	58	68
			± 5 %	29	49	59	69

Note

⁽¹⁾ For detailed tape specifications refer to packaging information: www.vishay.com/doc?28139

SPECIFIC REFERENCE DATA: 469

DESCRIPTION	VALUE			
Tangent of loss angle: C ≤ 0.1 μF 0.1 μF < C ≤ 0.47 μF 0.47 μF < C ≤ 1.0 μF	at 1 kHz	at 10 kHz	at 100 kHz	
	≤ 75 x 10 ⁻⁴	≤ 120 x 10 ⁻⁴	≤ 200 x 10 ⁻⁴	
	≤ 75 x 10 ⁻⁴	≤ 120 x 10 ⁻⁴	≤ 225 x 10 ⁻⁴	
	≤ 75 x 10 ⁻⁴	≤ 120 x 10 ⁻⁴	-	
Rated voltage pulse slope (dU/dt) _R at I _{max} = 12.5 mm	100 V _{DC}	250 V _{DC}	400 V _{DC}	630 V _{DC}
	30 V/μs	120 V/μs	170 V/μs	120 V/μs
R between leads, for C ≤ 0.33 μF at 100 V; 1 min at 500 V; 1 min	> 15 000 MΩ	> 30 000 MΩ	> 30 000 MΩ	> 30 000 MΩ
R between leads, for C > 0.33 μF at 100 V; 1 min at 500 V; 1 min	> 5000 s	> 10 000 s	> 10 000 s	> 10 000 s
R between interconnecting leads and casing, at 100 V; 1 min at 500 V; 1 min	> 30 000 MΩ	> 30 000 MΩ	> 30 000 MΩ	> 30 000 MΩ
Withstanding (DC) voltage (cut off current 10 mA) ⁽¹⁾ ; rise time ≤ 1000 V/s	160 V; 1 min	400 V; 1 min	640 V; 1 min	1008 V; 1 min
Withstanding (DC) voltage between leads and case	200 V; 1 min	500 V; 1 min	840 V; 1 min	1260 V; 1 min
Maximum application temperature	105 °C			

Note

⁽¹⁾ See "Voltage Proof Test for Metallized Film Capacitors": www.vishay.com/doc?28169

 $U_{RDC} = 100 \text{ V}$; $U_{RAC} = 63 \text{ V}$

C (μF)	DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 469 XXYYY AND PACKAGING						
			LOOSE IN BOX				REEL		C-VALUE
			l _t = 4.0 mm + 1.0 mm / - 0.5 mm		l _t = 22.0 mm ± 4.0 mm		H = 18.5 mm; P ₀ = 12.7 mm		
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	
Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm									
0.056	4.0 x 11.0 x 12.5	0.35							563
0.068			25...	26...	21...	22...	28...	29...	683
0.082			(2000)	(2000)	(1500)	(1500)	(1500)	(1500)	823
0.10									104
0.12	4.3 x 11.3 x 12.5	0.38	25... (2000)	26... (2000)	21... (1500)	22... (1500)	28... (1500)	29... (1500)	124
0.15	3.9 x 10.9 x 12.5	0.34	25... (2000)	26... (2000)	21... (1500)	22... (1500)	28... (1500)	29... (1500)	154
0.18	4.2 x 11.2 x 12.5	0.37	25... (2000)	26... (2000)	21... (1500)	22... (1500)	28... (1500)	29... (1500)	184
0.22	4.5 x 11.5 x 12.5	0.40	25... (2000)	26... (2000)	21... (1500)	22... (1500)	28... (1300)	29... (1300)	224
0.27	4.2 x 11.2 x 12.5	0.37	25... (2000)	26... (2000)	21... (1500)	22... (1500)	28... (1500)	29... (1500)	274
0.33	4.6 x 11.6 x 12.5	0.41	25... (2000)	26... (2000)	21... (1500)	22... (1500)	28... (1300)	29... (1300)	334
0.39	4.0 x 11.0 x 12.5	0.35	25... (2000)	26... (2000)	21... (1500)	22... (1500)	28... (1500)	29... (1500)	394
0.47	4.2 x 11.2 x 12.5	0.37	25... (2000)	26... (2000)	21... (1500)	22... (1500)	28... (1500)	29... (1500)	474
0.56	4.6 x 11.6 x 12.5	0.41	25... (2000)	26... (2000)	21... (1500)	22... (1500)	28... (1300)	29... (1300)	564
0.68	5.0 x 12.0 x 12.5	0.44	25... (1500)	26... (1500)	21... (1250)	22... (1250)	28... (1200)	29... (1200)	684
0.82	5.5 x 12.5 x 12.5	0.47	25... (1500)	26... (1500)	21... (1000)	22... (1000)	28... (1100)	29... (1100)	824
1.0	6.0 x 13.0 x 12.5	0.55	25... (1250)	26... (1250)	21... (1000)	22... (1000)	28... (1000)	29... (1000)	105

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only


 $U_{RDC} = 250 \text{ V}; U_{RAC} = 160 \text{ V}$

C (μF)	DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 469 XXYYY AND PACKAGING						
			LOOSE IN BOX				REEL		C-VALUE
			l _t = 4.0 mm + 1.0 mm / - 0.5 mm		l _t = 22.0 mm ± 4.0 mm		H = 18.5 mm; P ₀ = 12.7 mm		
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	..YYY
Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm									
0.027	4.2 x 11.2 x 12.5	0.37	45... (2000)	46... (2000)	41... (1500)	42... (1500)	48... (1500)	49... (1500)	273
0.033	4.6 x 11.6 x 12.5	0.41	45... (2000)	46... (2000)	41... (1500)	42... (1500)	48... (1300)	49... (1300)	333
0.039	4.0 x 11.0 x 12.5	0.35	45... (2000)	46... (2000)	41... (1500)	42... (1500)	48... (1500)	49... (1500)	393
0.047	4.1 x 11.1 x 12.5	0.36	45... (2000)	46... (2000)	41... (1500)	42... (1500)	48... (1500)	49... (1500)	473
0.056	4.0 x 11.0 x 12.5	0.35	45... (2000)	46... (2000)	41... (1500)	42... (1500)	48... (1500)	49... (1500)	563
0.068	4.1 x 11.1 x 12.5	0.36	45... (2000)	46... (2000)	41... (1500)	42... (1500)	48... (1500)	49... (1500)	683
0.082	4.4 x 11.4 x 12.5	0.39	45... (2000)	46... (2000)	41... (1500)	42... (1500)	48... (1500)	49... (1500)	823
0.10	4.0 x 11.0 x 12.5	0.35	45... (2000)	46... (2000)	41... (1500)	42... (1500)	48... (1500)	49... (1500)	104
0.12	4.3 x 11.3 x 12.5	0.38	45... (2000)	46... (2000)	41... (1500)	42... (1500)	48... (1500)	49... (1500)	124
0.15	4.8 x 11.8 x 12.5	0.42	45... (2000)	46... (2000)	41... (1250)	42... (1250)	48... (1300)	49... (1300)	154
0.18	5.2 x 12.2 x 12.5	0.45	45... (1500)	46... (1500)	41... (1000)	42... (1000)	48... (1200)	49... (1200)	184
0.22	5.8 x 12.8 x 12.5	0.50	45... (1500)	46... (1500)	41... (1000)	42... (1000)	48... (1100)	49... (1100)	224

Notes

- SPQ = Standard Packing Quantity

⁽¹⁾ Net weight for short lead product only

 $U_{RDC} = 400\text{ V}$; $U_{RAC} = 220\text{ V}$

C (μF)	DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 469 XYYYY AND PACKAGING							C-VALUE ..YYY
			LOOSE IN BOX				REEL			
			l _t = 4.0 mm + 1.0 mm / - 0.5 mm		l _t = 22.0 mm ± 4.0 mm		H = 18.5 mm; P ₀ = 12.7 mm			
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %		
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)		
Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm										
0.0010 0.0012 0.0015 0.0018	4.5 x 11.5 x 12.5	0.40	55...	56...	51...	52...	58...	59...	102 122 152 182	
			(2000)	(2000)	(1500)	(1500)	(1300)	(1300)		
0.0022	4.0 x 11.0 x 12.5	0.35	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	222	
0.0027	4.3 x 11.3 x 12.5	0.38	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	272	
0.0033	4.6 x 11.6 x 12.5	0.41	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1300)	59... (1300)	332	
0.0039	4.0 x 11.0 x 12.5	0.35	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	392	
0.0047	4.1 x 11.1 x 12.5	0.36	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	472	
0.0056	4.6 x 11.6 x 12.5	0.41	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1300)	59... (1300)	562	
0.0068	4.2 x 11.2 x 12.5	0.37	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	682	
0.0082	4.6 x 11.6 x 12.5	0.41	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1300)	59... (1300)	822	
0.010	4.1 x 11.1 x 12.5	0.36	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	103	
0.012	4.5 x 11.5 x 12.5	0.40	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1300)	59... (1300)	123	
0.015	4.1 x 11.1 x 12.5	0.36	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	153	
0.018	4.5 x 11.5 x 12.5	0.40	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1300)	59... (1300)	183	
0.022	4.0 x 11.0 x 12.5	0.35	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	223	
0.027	4.2 x 11.2 x 12.5	0.37	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	273	
0.033	4.6 x 11.6 x 12.5	0.41	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1300)	59... (1300)	333	
0.039	5.0 x 12.0 x 12.5	0.44	55... (1500)	56... (1500)	51... (1250)	52... (1250)	58... (1200)	59... (1200)	393	
0.047	4.1 x 11.1 x 12.5	0.36	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	473	
0.056	4.4 x 11.4 x 12.5	0.39	55... (2000)	56... (2000)	51... (1500)	52... (1500)	58... (1500)	59... (1500)	563	
0.068	4.8 x 11.8 x 12.5	0.42	55... (2000)	56... (2000)	51... (1250)	52... (1250)	58... (1300)	59... (1300)	683	
0.082	5.4 x 12.4 x 12.5	0.46	55... (1500)	56... (1500)	51... (1000)	52... (1000)	58... (1200)	59... (1200)	823	
0.10	5.7 x 12.7 x 12.5	0.48	55... (1500)	56... (1500)	51... (1000)	52... (1000)	58... (1100)	59... (1100)	104	

Notes

- SPQ = Standard Packing Quantity

⁽¹⁾ Net weight for short lead product only

 $U_{RDC} = 630 \text{ V}$; $U_{RAC} = 250 \text{ V}$

C (μF)	DIMENSIONS w _{max.} x h _{max.} x l _{max.} (mm)	MASS (g) ⁽¹⁾	CATALOG NUMBER BFC2 469 XYYYY AND PACKAGING						
			LOOSE IN BOX				REEL		C-VALUE
			l _t = 4.0 mm + 1.0 mm / - 0.5 mm		l _t = 22.0 mm ± 4.0 mm		H = 18.5 mm; P ₀ = 12.7 mm		
			C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	C-TOL. = ± 10 %	C-TOL. = ± 5 %	
			XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	XX (SPQ)	
Pitch = 10.0 mm ± 0.4 mm; d _t = 0.60 mm ± 0.06 mm									
0.010	4.1 x 11.1 x 12.5	0.36	65... (2000)	66... (2000)	61... (1500)	62... (1500)	68... (1500)	69... (1500)	103
0.012	4.5 x 11.5 x 12.5	0.40	65... (2000)	66... (2000)	61... (1500)	62... (1500)	68... (1300)	69... (1300)	123
0.015	4.9 x 11.9 x 12.5	0.43	65... (2000)	66... (2000)	61... (1250)	62... (1250)	68... (1200)	69... (1200)	153
0.018	5.4 x 12.4 x 12.5	0.46	65... (1500)	66... (1500)	61... (1000)	62... (1000)	68... (1100)	69... (1100)	183
0.022	4.8 x 11.8 x 12.5	0.42	65... (2000)	66... (2000)	61... (1250)	62... (1250)	68... (1300)	69... (1300)	223
0.027	5.3 x 12.3 x 12.5	0.46	65... (2000)	66... (2000)	61... (1000)	62... (1000)	68... (1200)	69... (1200)	273
0.033	5.9 x 12.9 x 12.5	0.52	65... (1500)	66... (1500)	61... (1000)	62... (1000)	68... (1100)	69... (1100)	333

Notes

- SPQ = Standard Packing Quantity
- ⁽¹⁾ Net weight for short lead product only

MOUNTING**Normal Use**

The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoliers are designed for mounting in printed-circuit boards by means of automatic insertion machines.

For detailed tape specifications refer to packaging information: www.vishay.com/doc?28139

Specific Method of Mounting to Withstand Vibration and Shock

In order to withstand vibration and shock tests, it must be ensured that the underside and the kinks are in good contact with the printed-circuit board.

- For pitches $\leq 15 \text{ mm}$ capacitors shall be mechanically fixed by the leads
- For larger pitches the capacitors shall be mounted in the same way and the body clamped

Storage Temperature

$T_{\text{stg}} = -25 \text{ }^{\circ}\text{C}$ to $+35 \text{ }^{\circ}\text{C}$ with RH maximum 75 % without condensation

SOLDERING

For general soldering conditions and wave soldering profile, we refer to the application note:

“Soldering Guidelines for Film Capacitors”: www.vishay.com/doc?28171

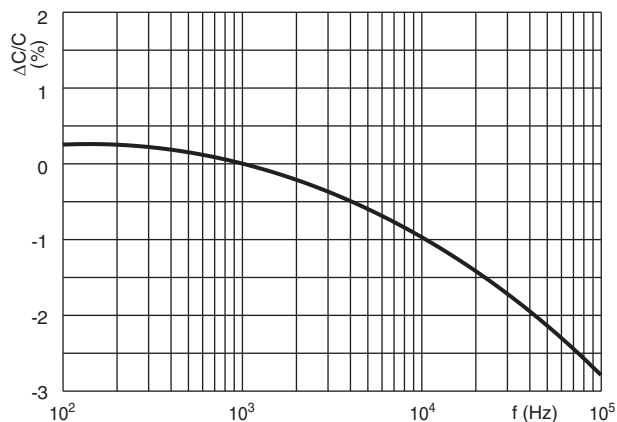
Ratings and Characteristics Reference Conditions

Unless otherwise specified, all electrical values apply to an ambient free air temperature of $23 \text{ }^{\circ}\text{C} \pm 1 \text{ }^{\circ}\text{C}$, an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of $50 \% \pm 2 \%$.

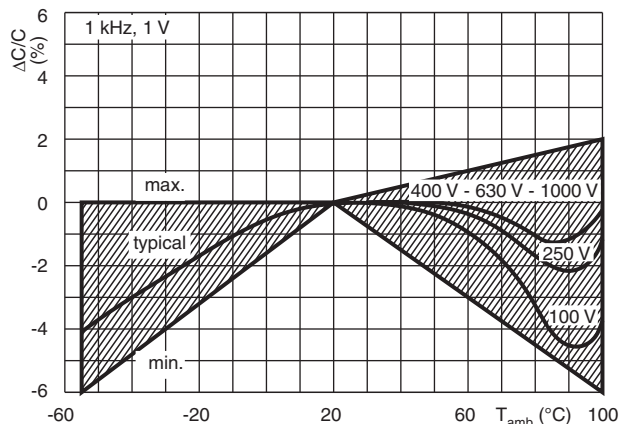
For reference testing, a conditioning period shall be applied over $96 \text{ h} \pm 4 \text{ h}$ by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.



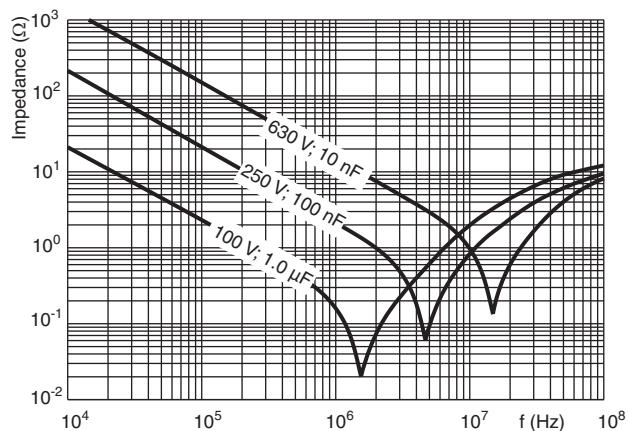
CHARACTERISTICS



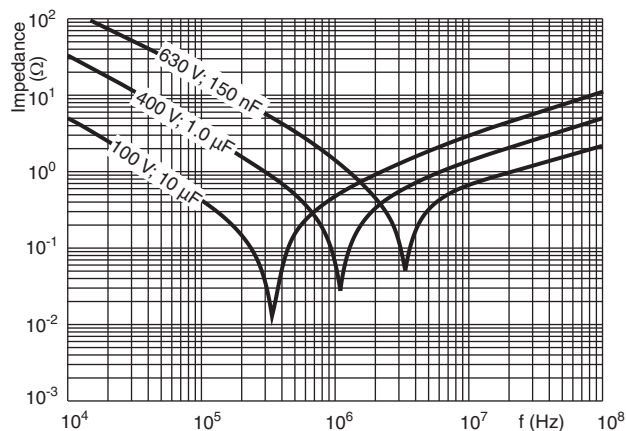
Capacitance as a function of frequency
(typical curve)



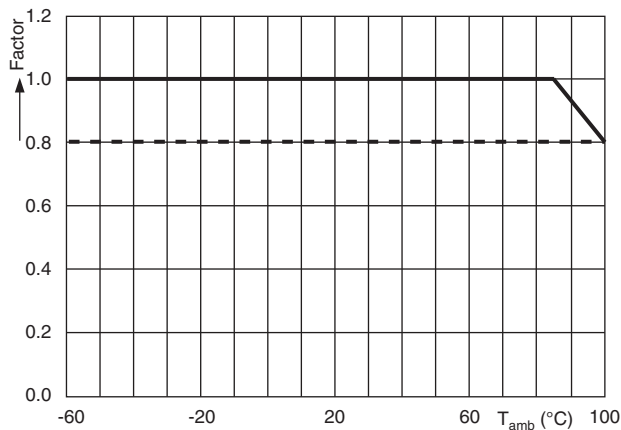
Capacitance as a function of ambient temperature
(typical curve)



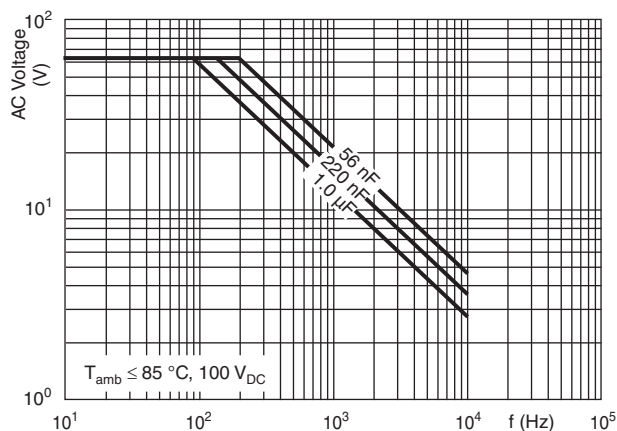
467, 469 - Impedance as a function of frequency
(typical curve)



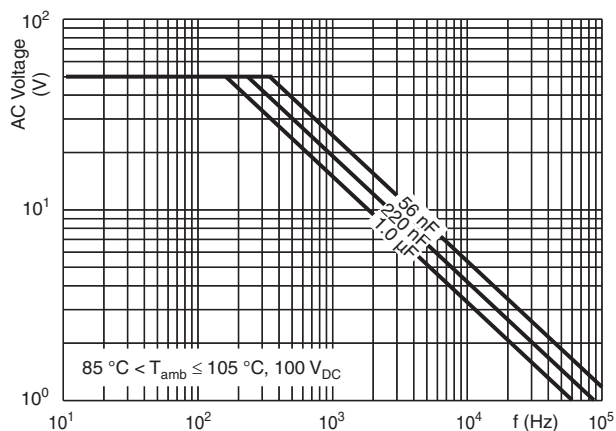
468 - Impedance as a function of frequency
(typical curve)



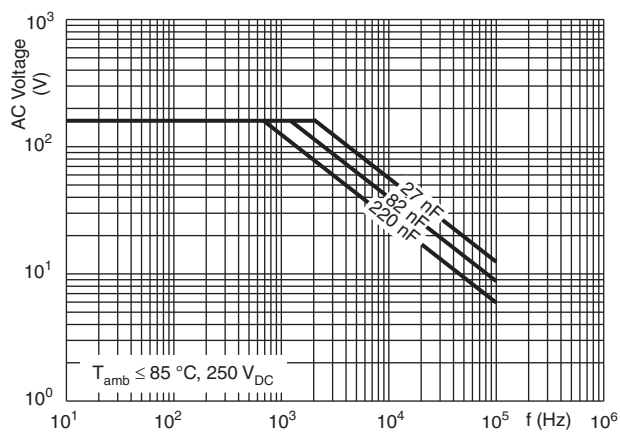
Max. DC and AC voltage as a function of temperature



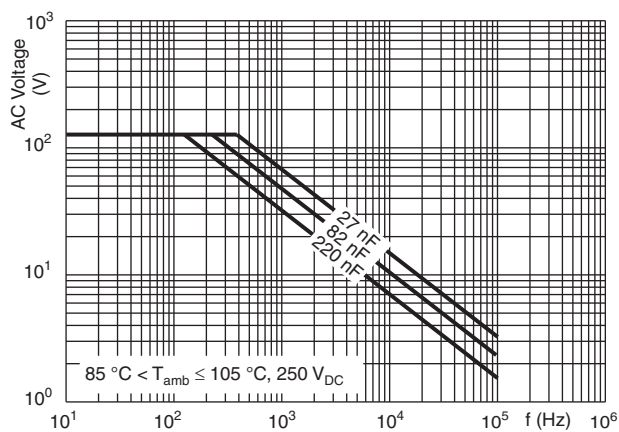
467, 469 - Max. RMS voltage as a function of frequency



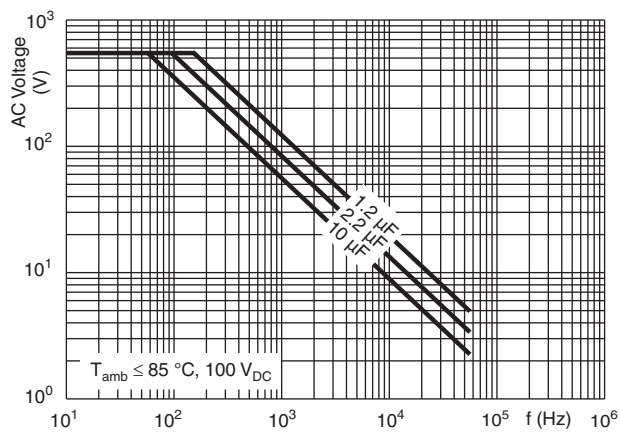
467, 469 - Max. RMS voltage as a function of frequency



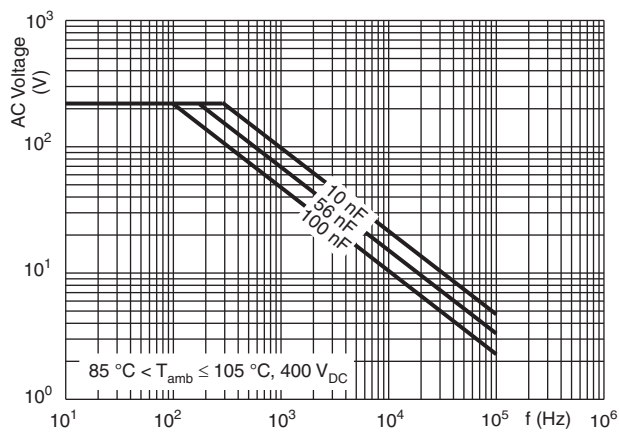
467, 469 - Max. RMS voltage as a function of frequency



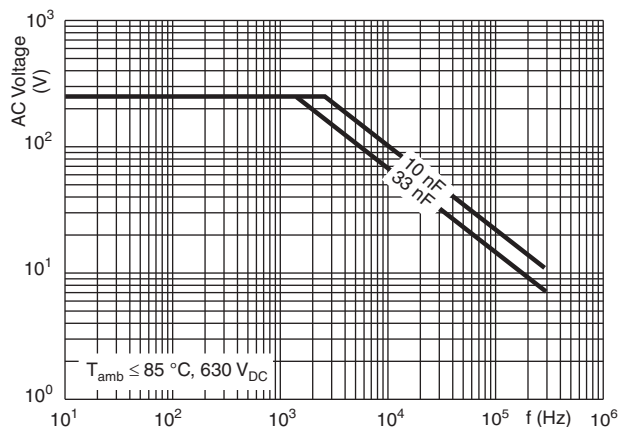
467, 469 - Max. RMS voltage as a function of frequency



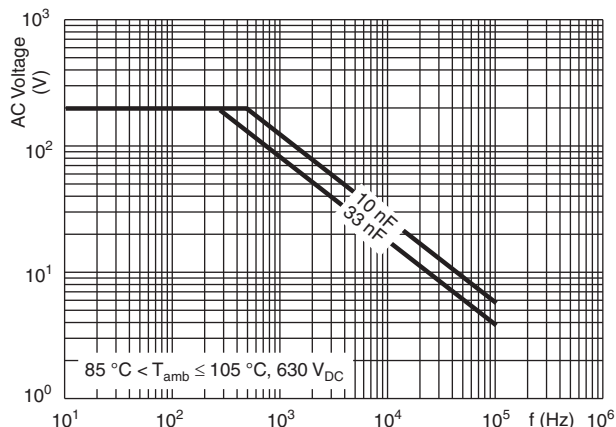
467, 469 - Max. RMS voltage as a function of frequency



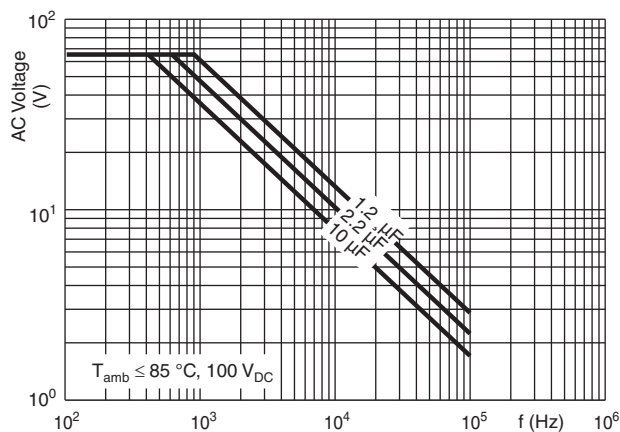
467, 469 - Max. RMS voltage as a function of frequency



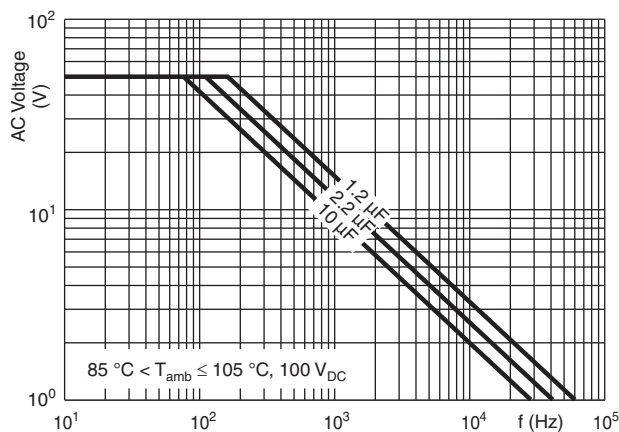
467, 469 - Max. RMS voltage as a function of frequency



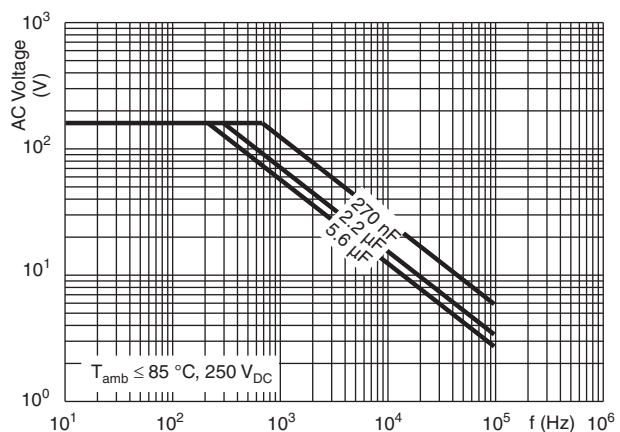
467, 469 - Max. RMS voltage as a function of frequency



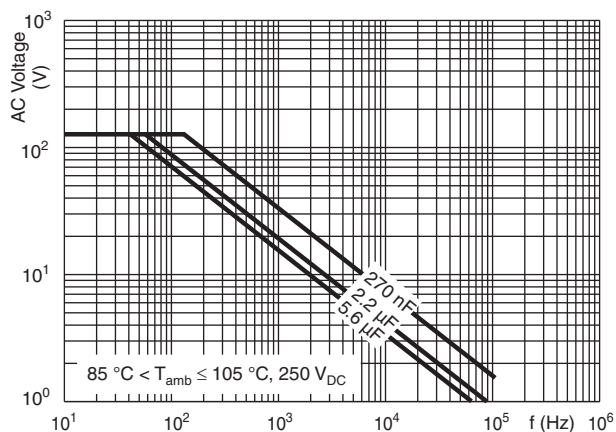
468 - Max. RMS voltage as a function of frequency



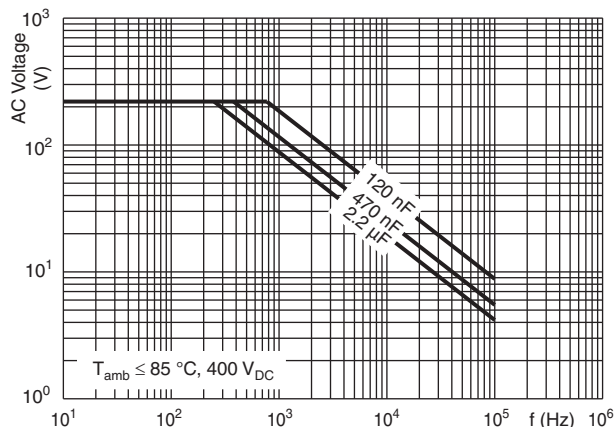
468 - Max. RMS voltage as a function of frequency



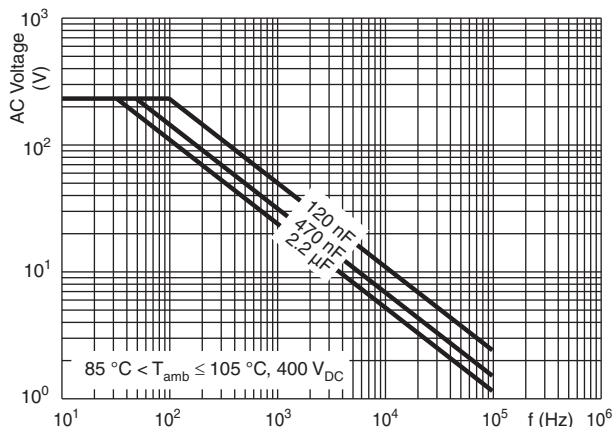
468 - Max. RMS voltage as a function of frequency



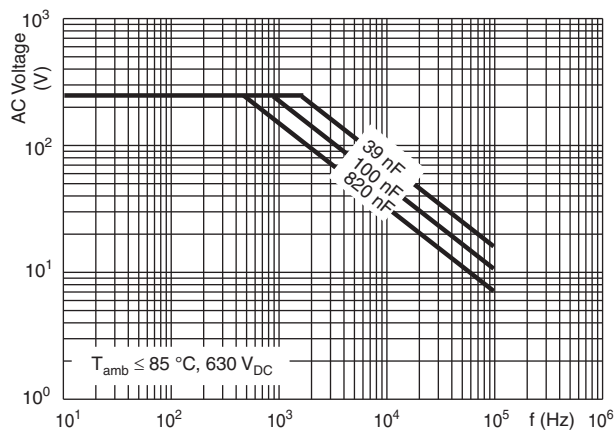
468 - Max. RMS voltage as a function of frequency



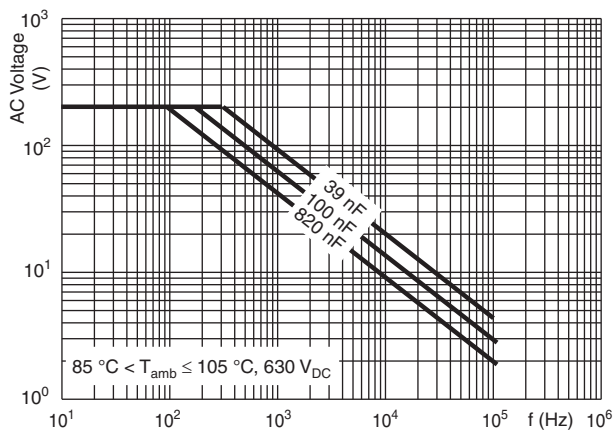
468 - Max. RMS voltage as a function of frequency



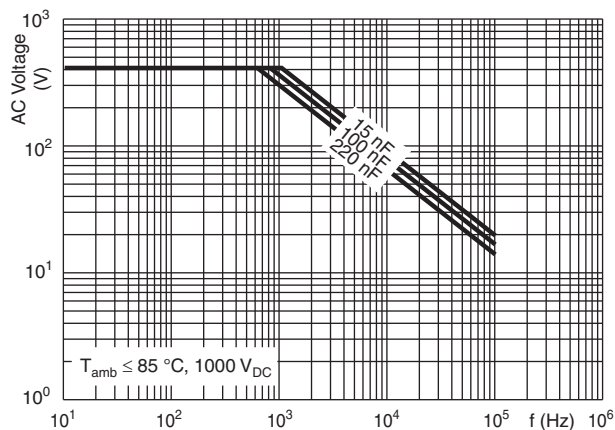
468 - Max. RMS voltage as a function of frequency



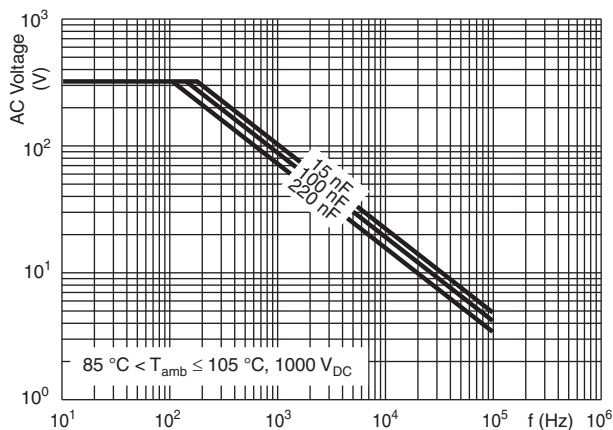
468 - Max. RMS voltage as a function of frequency



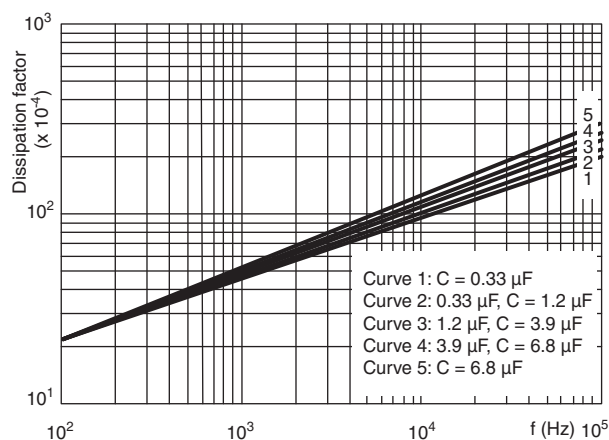
468 - Max. RMS voltage as a function of frequency



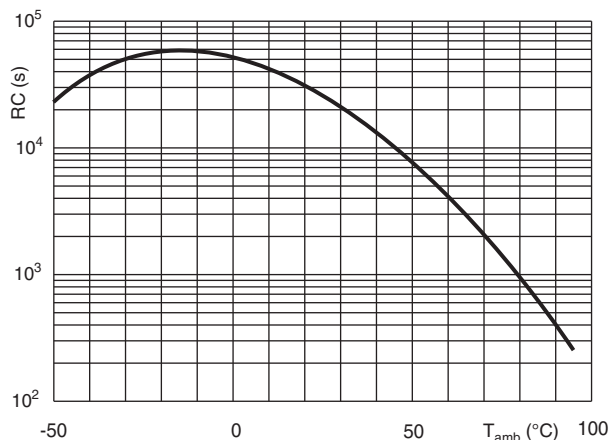
468 - Max. RMS voltage as a function of frequency



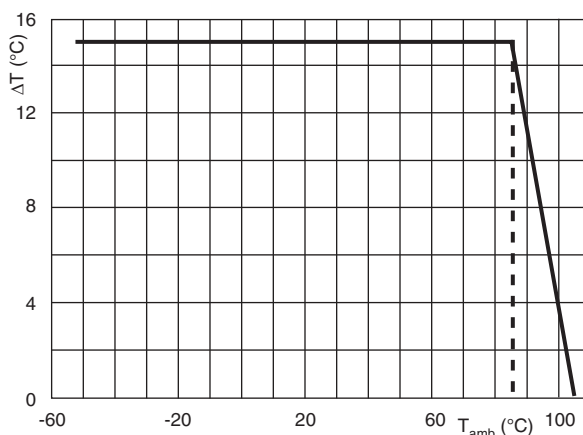
468 - Max. RMS voltage as a function of frequency



Tangent of loss angle as a function of frequency
(typical curve)



Insulation resistance as a function of the
ambient temperature (typical curve)



Maximum allowed component temperature rise (ΔT)
as a function of the ambient temperature (T_{amb})

HEAT CONDUCTIVITY (G) AS A FUNCTION OF (ORIGINAL) PITCH AND CAPACITOR BODY THICKNESS IN mW/°C

$W_{max.}$ (mm)	HEAT CONDUCTIVITY (mW/°C)			
	PITCH 10 mm	PITCH 15.5 mm	PITCH 22.5 mm	PITCH 27.5 mm
4.0	4.0	5.0	-	-
4.5	4.5	6.0	-	-
5.0	5.0	6.0	12.0	13.0
5.5	6.0	6.5	13.0	15.0
6.0	6.0	6.5	13.0	15.0
6.5	6.5	8.0	15.0	17.0
7.0	-	8.0	15.0	17.0
7.5	-	9.0	17.0	18.0
8.0	-	9.0	17.0	20.0
8.5	-	11.0	18.0	20.0
9.0	-	11.0	18.0	22.0
9.5	-	12.0	20.0	22.0
10.0	-	12.0	20.0	23.0
10.5	-	-	22.0	25.0
11.0	-	-	-	25.0
11.5	-	-	-	27.0

$W_{max.}$ (mm)	HEAT CONDUCTIVITY (mW/°C)			
	PITCH 10 mm	PITCH 15.5 mm	PITCH 22.5 mm	PITCH 27.5 mm
12.0	-	-	-	27.0
12.5	-	-	-	30.0
13.0	-	-	-	30.0
13.5	-	-	-	30.0
14.0	-	-	-	30.0
14.5	-	-	-	33.0
15.0	-	-	-	33.0
15.5	-	-	-	37.0
16.0	-	-	-	37.0

POWER DISSIPATION AND MAXIMUM COMPONENT TEMPERATURE RISE

The power dissipation must be limited in order not to exceed the maximum allowed component temperature rise as a function of the free ambient temperature.

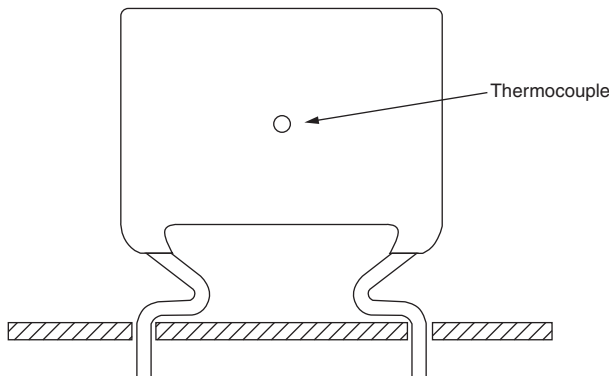
The power dissipation can be calculated according type detail specification "HQN-384-01/101: Technical Information Film Capacitors".

The component temperature rise (ΔT) can be measured (see section "Measuring the component temperature" for more details) or calculated by $\Delta T = P/G$:

- ΔT = component temperature rise (°C)
- P = power dissipation of the component (mW)
- G = heat conductivity of the component (mW/°C)

MEASURING THE COMPONENT TEMPERATURE

A thermocouple must be attached to the capacitor body as in:



The temperature is measured in unloaded (T_{amb}) and maximum loaded condition (T_C).

The temperature rise is given by $\Delta T = T_C - T_{amb}$.

To avoid radiation or convection, the capacitor should be tested in a wind-free box.

APPLICATION NOTE AND LIMITING CONDITIONS

These capacitors are not suitable for mains applications as across-the-line capacitors without additional protection, as described hereunder. These mains applications are strictly regulated in safety standards and therefore electromagnetic interference suppression capacitors conforming the standards must be used.

For capacitors connected in parallel, normally the proof voltage and possibly the rated voltage must be reduced. For information depending of the capacitance value and the number of parallel connections contact: dc-film@vishay.com

To select the capacitor for a certain application, the following conditions must be checked:

1. The peak voltage (U_P) shall not be greater than the rated DC voltage (U_{RDC})
2. The peak-to-peak voltage (U_{P-P}) shall not be greater than $2\sqrt{2} \times U_{RAC}$ to avoid the ionization inception level

3. The voltage pulse slope (dU/dt) shall not exceed the rated voltage pulse slope in an RC-circuit at rated voltage and without ringing. If the pulse voltage is lower than the rated DC voltage, the rated voltage pulse slope may be multiplied by U_{RDC} and divided by the applied voltage.

For all other pulses following equation must be fulfilled:

$$2 \times \int_0^T \left(\frac{dU}{dt} \right)^2 \times dt < U_{RDC} \times \left(\frac{dU}{dt} \right)_{rated}$$

T is the pulse duration.

The rated voltage pulse slope is valid for ambient temperatures up to 85 °C. For higher temperatures a derating factor of 3 % per K shall be applied.

4. The maximum component surface temperature rise must be lower than the limits (see graph “Max. allowed component temperature rise”).
5. Since in circuits used at voltages over 280 V peak-to-peak the risk for an intrinsically active flammability after a capacitor breakdown (short circuit) increases, it is recommended that the power to the component is limited to 100 times the values mentioned in the table: “Heat Conductivity”
6. When using these capacitors as across-the-line capacitor in the input filter for mains applications or as series connected with an impedance to the mains the applicant must guarantee that the following conditions are fulfilled in any case (spikes and surge voltages from the mains included).

VOLTAGE CONDITIONS FOR 6 ABOVE

ALLOWED VOLTAGES	$T_{amb} \leq 85\text{ °C}$	$85\text{ °C} < T_{amb} \leq 105\text{ °C}$
Maximum continuous RMS voltage	U_{RAC}	$0.8 \times U_{RAC}$
Maximum temperature RMS-overvoltage (< 24 h)	$1.25 \times U_{RAC}$	U_{RAC}
Maximum peak voltage (V_{O-P}) (< 2 s)	$1.6 \times U_{RAC}$	$1.3 \times U_{RAC}$

Example

C = 330 nF - 100 V used for the voltage signal shown in next drawing.

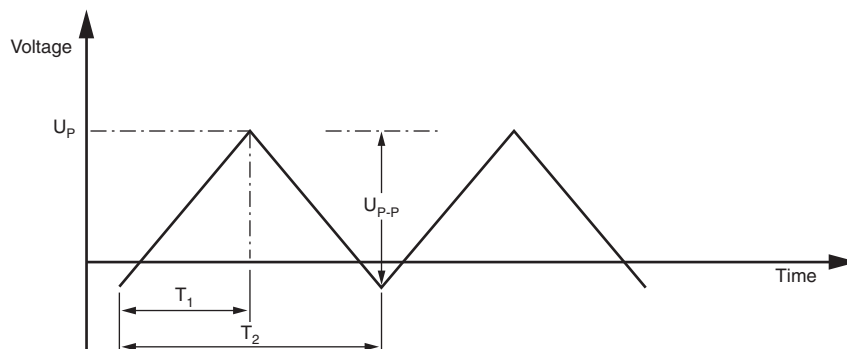
$U_{P-P} = 80\text{ V}$; $U_P = 70\text{ V}$; $T_1 = 0.5\text{ ms}$; $T_2 = 1\text{ ms}$

The ambient temperature is 35 °C

Checking conditions:

1. The peak voltage $U_P = 70\text{ V}$ is lower than 100 V_{DC}
2. The peak-to-peak voltage 80 V is lower than $2\sqrt{2} \times 63\text{ V}_{AC} = 178\text{ V}_{P-P}$
3. The voltage pulse slope (dU/dt) = $80\text{ V}/500\text{ }\mu\text{s} = 0.16\text{ V}/\mu\text{s}$
This is lower than $20\text{ V}/\mu\text{s}$ (see specific reference data for each version)
4. The dissipated power is 60 mW as calculated with fourier terms
The temperature rise for $W_{max.} = 8.5\text{ mm}$ and pitch = 15 mm will be $60\text{ mW}/11\text{ mW}/\text{°C} = 5.5\text{ °C}$
This is lower than 15 °C temperature rise at 35 °C, according figure “Max. allowed component temperature rise”
5. Not applicable
6. Not applicable

Voltage Signal





INSPECTION REQUIREMENTS

General Notes

Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, Publication IEC 60384-2 and Specific Reference Data”.

Group C Inspection Requirements

SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1		
4.1 Dimensions (detail)		As specified in chapters “General Data” of this specification
4.3.1 Initial measurements	Capacitance Tangent of loss angle: for $C \leq 470$ nF at 100 kHz or for $C > 470$ nF at 10 kHz	
4.3 Robustness of terminations	Tensile: load 10 N; 10 s Bending: load 5 N; 4 x 90°	No visible damage
4.4 Resistance to soldering heat	Method: 1A Solder bath: 280 °C ± 5 °C Duration: 10 s	
4.14 Component solvent resistance	Isopropylalcohol at room temperature Method: 2 Immersion time: 5 min ± 0.5 min Recovery time: min. 1 h, max. 2 h	
4.4.2 Final measurements	Visual examination Capacitance Tangent of loss angle	No visible damage Legible marking $ \Delta C/C \leq 2$ % of the value measured initially Increase of $\tan \delta$ ≤ 0.005 for: $C \leq 100$ nF or ≤ 0.010 for: 100 nF < $C \leq 220$ nF or ≤ 0.015 for: 220 nF < $C \leq 470$ nF and ≤ 0.003 for: $C > 470$ nF Compared to values measured in 4.3.1
SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1		
4.6.1 Initial measurements	Capacitance Tangent of loss angle: for $C \leq 470$ nF at 100 kHz or for $C > 470$ nF at 10 kHz	No visible damage
4.6 Rapid change of temperature	$\theta A = -55$ °C $\theta B = +100$ °C 5 cycles Duration $t = 30$ min	
4.7 Vibration	Visual examination Mounting: see section “Mounting” of this specification Procedure B4 Frequency range: 10 Hz to 55 Hz Amplitude: 0.75 mm or Acceleration 98 m/s ² (whichever is less severe) Total duration 6 h	No visible damage
4.7.2 Final inspection	Visual examination	No visible damage



SUB-CLAU SE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.9 Shock	Mounting: see section "Mounting" of this specification Pulse shape: half sine Acceleration: 490 m/s ² Duration of pulse: 11 ms	
4.9.3 Final measurements	Visual examination Capacitance Tangent of loss angle Insulation resistance	No visible damage $ \Delta C/C \leq 3\%$ of the value measured in 4.6.1 Increase of $\tan \delta$ ≤ 0.005 for: $C \leq 100$ nF or ≤ 0.010 for: 100 nF $< C \leq 220$ nF or ≤ 0.015 for: 220 nF $< C \leq 470$ nF and ≤ 0.003 for: $C > 470$ nF Compared to values measured in 4.6.1 As specified in section "Insulation Resistance" of this specification
SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B		
4.10 Climatic sequence		
4.10.2 Dry heat	Temperature: +105 °C Duration: 16 h	
4.10.3 Damp heat cyclic Test Db, first cycle		
4.10.4 Cold	Temperature: -55 °C Duration: 2 h	
4.10.6 Damp heat cyclic Test Db, remaining cycles		
4.10.6.2 Final measurements	Voltage proof = U_{RDC} for 1 min within 15 min after removal from test chamber Visual examination Capacitance Tangent of loss angle Insulation resistance	No breakdown or flash-over No visible damage Legible marking $ \Delta C/C \leq 5\%$ of the value measured in 4.4.2 or 4.9.3 Increase of $\tan \delta$ ≤ 0.007 for: $C \leq 100$ nF or ≤ 0.010 for: 100 nF $< C \leq 220$ nF or ≤ 0.015 for: 220 nF $< C \leq 470$ nF and ≤ 0.005 for: $C > 470$ nF Compared to values measured in 4.3.1 or 4.6.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification



SUB-CLAUSE NUMBER AND TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
SUB-GROUP C2		
4.11 Damp heat steady state	56 days, 40 °C, 90 % to 95 % RH	
4.11.1 Initial measurements	Capacitance Tangent of loss angle at 1 kHz	
4.11.3 Final measurements	Voltage proof = U_{RDC} for 1 min within 15 min after removal from test chamber Visual examination Capacitance Tangent of loss angle Insulation resistance	No breakdown or flash-over No visible damage Legible marking $ \Delta C/C \leq 5\%$ of the value measured in 4.11.1. Increase of $\tan \delta \leq 0.005$ Compared to values measured in 4.11.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification
SUB-GROUP C3		
4.12 Endurance	Duration: 2000 h $1.25 \times U_{RDC}$ at 85 °C $1.0 \times U_{RDC}$ at 105 °C	
4.12.1 Initial measurements	Capacitance Tangent of loss angle: for $C \leq 470$ nF at 100 kHz or for $C > 470$ nF at 10 kHz	
4.12.5 Final measurements	Visual examination Capacitance Tangent of loss angle Insulation resistance	No visible damage Legible marking $ \Delta C/C \leq 5\%$ compared to values measured in 4.12.1 Increase of $\tan \delta$ ≤ 0.005 for: $C \leq 100$ nF or ≤ 0.010 for: 100 nF $< C \leq 220$ nF or ≤ 0.015 for: 220 nF $< C \leq 470$ nF and ≤ 0.003 for: $C > 470$ nF Compared to values measured in 4.12.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification
SUB-GROUP C4		
4.13 Charge and discharge	10 000 cycles Charged to U_{RDC} Discharge resistance: $R = \frac{U_R}{C \times 2.5 \times (dU/dt)_R}$	
4.13.1 Initial measurements	Capacitance Tangent of loss angle: for $C \leq 470$ nF at 100 kHz or for $C > 470$ nF at 10 kHz	
4.13.3 Final measurements	Capacitance Tangent of loss angle Insulation resistance	$ \Delta C/C \leq 3\%$ compared to values measured in 4.13.1 Increase of $\tan \delta$ ≤ 0.005 for: $C \leq 100$ nF or ≤ 0.010 for: 100 nF $< C \leq 220$ nF or ≤ 0.015 for: 220 nF $< C \leq 470$ nF and ≤ 0.003 for: $C > 470$ nF Compared to values measured in 4.13.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification



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